MAYER'S ONTOGENY AND PHYLOGENY OF INSECTS.[1]

"ONTOGENY" is a term devised by Haeckel, and means the development or embryonic and post-embryonic changes of the individual; "phylogeny" corresponds to its English equivalent, "ancestry," while the present essay is an attempt to explain the origin and ancestry of the six-footed insects (Hexapoda) from embryological and anatomical data. No new facts, so far as we are aware, are presented by the author, whose essay has, apparently, contrary to usage in German universities, been crowned not for the original work it contains but for the ideas suggested by the labors of preceding authors.

In trying to reconstruct the form of the primitive insect, Mayer insists that it should be done from a study of the winged adult or *imago*, "since *a priori* we cannot know how far the form of the larva is original or secondary." Other authors have with better reasons derived the ancestral form from the larva.

Mayer's ancestral insect, then, which he calls *Protentomon*, had a body divided into a head, thorax, and abdomen, the latter consisting of eleven segments, while there were six thoracic feet with five-jointed tarsi, and two pairs of wings, nine (and perhaps eleven) pairs of stigmata, a pair of salivary glands, and four excretory organs or Malpighian vessels, besides a well-developed nervous system, heart, and an aorta, as usual in existing insects.

This hypothetical *Protentomon* is derived by Mayer from the worms,[2] in opposition to the suggestions of Fritz Müller and Brauer that the insects originated from the Crustacea. This worm (1), the parent of the half a million species of insects which have peopled the globe during the present and past ages, was "an unjointed worm, a common starting-point for the Tracheata and higher worms, and also a near relation of the ancestral form of the Crustacea." This worm then (2) transformed into a higher organism, with eighteen joints to its body and at least fourteen pairs of segmental organs, with perhaps also a masticatory apparatus in the form of jaws; and was perhaps nearly related to

[1] Ueber Ontogenie und Phylogenie der Insekten. Eine akademische Preisschrift. Von Dr. Paul Mayer, in Jena. Jenaische Zeitschrift für Naturwissenschaft., x., heft 2. Jena. 1876. With four plates, pp. 125–221.

[2] This view was advocated by the writer (though Mayer does not mention it) in Our Common Insects, chapter xiii., entitled Ancestry of Insects (1873). This is the more inexcusable since Dr. Mayer quotes from the essay.

the existing Annelids. (3.) A third step towards the insects was a form similar to the second, but with ventral and perhaps also dorsal appendages on all the segments; it was still aquatic. It transformed (4) into a worm with tracheæ and with dissimilar segments (the appendages in part beginning to disappear). It lived in fresh water, and is called by our author *Prototracheas*. (5.) This *Prototracheas* became an *Archentomon*, still aquatic, with six feet, and clearly defined head, thorax, and abdomen. Finally this fifth form acquired two pairs of wings, was terrestrial in its habits, and became (6) a *Protentomon*.

The author then discusses the ancestry of the different orders of insects. It is noticeable that in treating of them he begins with the Hymenoptera and ends with the Neuroptera, following in fact, unconsciously, the reviewer's classification proposed in 1863. The Linnæan Neuroptera are, however, broken up into several orders, the author following the usual German system; but Mayer is the first German author, so far as we are aware, who places the Hymenoptera at the head of the insects, and the Coleoptera in the neighborhood of the Hemiptera and Orthoptera, where they unquestionably belong.

Mayer adopts the suggestions of Bütschli and Semper that the air-tubes of insects originated from the segmental organs of worms, and, discarding Gegenbaur's view that the air-tubes were at first internal, closed air-sacs, he believes that the stigmata or breathing holes were the first to be formed. It may be objected that as insects are already provided with renal vessels, it is not necessary to suppose that segmental organs (also in part excretory) survived in them, and the inquiry arises whether the air-tubes of insects may not have arisen from the water-vascular system of the lower worms, which communicates with two or more external openings. In framing hypotheses like these, one guess may be as good as another.

The author, in a foot-note, combats with considerable unction our suggestion, made in 1867, that the head of insects consisted of seven segments. It may be observed that at that time we were influenced by the prevailing views of Agassiz, Dana, and others, who regarded the ocelli and eyes as homologues of the limbs. This view was corrected in the Memoirs of the Peabody Academy of Science, ii. 21, 1871 (a work from which our author quotes), and also in several other places, including the Guide to the Study of Insects, third edition, 1872; and the view that the normal number of cephalic segments is four was at the same time and in the same places insisted upon.

Dr. Mayer also quotes us as believing that the parts of the ovipositor are not homologous with the legs, a view we suggested in 1866, but after fresh embryological studies retracted in the above-mentioned Memoir in 1871 (which the author seems to have read), and also in other places, notably the essay on the Ancestry of Insects, quoted by Mayer, where the view that the ovipositor of the Hymenoptera, Hemiptera

(Cicada), and Orthoptera, as well as the spring of the Thysanura and the spinnerets of spiders, are homologues of the legs is emphasized.

As regards the position of the primitive band of insects, Mayer ignores the remarks of Dr. Dohrn on its significance in classification, and considers that the circumstance whether the primitive band is external or floats within the yolk is of much importance, laying down the law that "insects with an external primitive streak are in general older than those with an inner." We have previously[1] objected to Dohrn's classification of insects into "ectoblasts" and "entoblasts," and would make a similar objection to Mayer's views, since in weevils (*Attelabus*), abundantly proved by Dr. Le Conte to be the oldest of Coleoptera (a fact ignored by Dr. Mayer, whose genealogical tree of Coleoptera represents the antiquated classification of this order), we demonstrated that the primitive band is external, while in *Telephorus* it is internal, though our observations are called in question by Dr. Mayer, who, however, so far as we know, has never published any observations on the embryology of this or any other animal, the entire essay being based on facts observed by previous writers.

While the essay is interesting and suggestive, the leading idea, that hexapodous insects first appeared as winged organisms and not as larval forms, will, we think, be found to have no valid foundation. We should with as much reason derive the acalephs from an ancestral free-swimming medusa, and not from a hydra-like form, or the Amphibia from the tailless rather than the tailed forms, views with which we imagine few zoölogists would agree. — A. S. Packard, Jr.

[1] Embryological Studies on Hexapodous Insects. Memoirs of the Peabody Academy of Science, 1872, p. 15.